ACID MINE DRAINAGE

Acid rock drainage, which forms when rain or groundwater seeps into a mine or through a pile of tailings, pollutes thousands of miles of streams in the United States. When water comes into contact with sulfide minerals and oxygen, it produces sulfuric acid.

Naturally occurring bacteria rapidly accelerate this process. The acid ends up in streams, where it kills fish and other organisms. The rates of flow range from one to 100 gallons per minute, depending on the mine site, geography and weather. Traditional treatments include neutralizing the drainage with an alkaline material such as lime, or constructing wetlands, where the contaminated water seeps into mud containing naturally occurring bacteria that remove the pollutants. At secluded high altitude ore mines in the western United States, traditional treatments are expensive or impossible. Lime treatments produce sludge, which require large investments in equipment and labor for disposal. Construction of wetlands is impossible in areas that have little flat ground for ponds and wide temperature swings that affect plant andmicrobe survival.

Researchers at the Idaho National Engineering and Environmental Laboratory have developed and patented a technology that emulates a natural process in which water contaminated with metal sulfates flows into wetlands mud where naturally occurring bacteria remove the contaminants. They estimate that the combined capital and operating costs are about one-third those of lime treatment. The sludge produced is a fraction of that produced by liming.

Concrete modules equipped with baffles can be transported to waste sites and combined to form bioreactors of any size. A typical module is 5 feet wide, 4 feet high and 8 feet long. At the site, workers put in a layer of gravel, followed by a layer of mud, and topped with a layer of sawdust. The system does not have to be inoculated with microbes, because naturally occurring bacteria already live in the mud. Wastewater moves into the bioreactor and flows down the baffles. Naturally occurring fungi in the sawdust feed on it and produce carbohydrates. Bacteria in the sawdust's deeper layers feed on the carbohydrates to produce organic acids. In the mud, sulfate-reducing bacteria oxidize the acids. The sulfate-reducing bacteria, in turn, reduce the sulfates to sulfides, which precipitate from solution with the metals.

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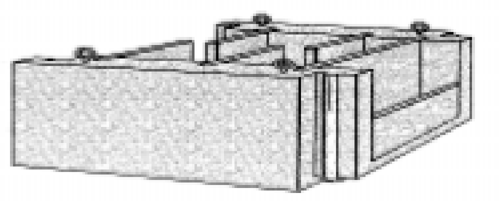
When the mud becomes saturated with sulfides, it can be replaced.

INEEL scientists have tested the process in the laboratory with acid rock drainage from copper, cobalt and iron mines and removed up to 99 percent of the metals from the water. In the case of extremely low pH and very high (greater than 5,000 ppm) metal contents, they recommend combining the system with other passive technologies, such as limestone drains. The researchers have designed typical modules that, when combined in series or in parallel configurations, can handle 100 gallons per minute.

INEEL researchers are looking for a mine site in which to field-test the bioreactor. But the technology has a much wider use than just preventing stream pollution around mine tailings.

The researchers stress that it can be used to remediate other streams that contain metals, sulfates, and nitrates, such as agricultural wastewater, currently one of the more serious sources of pollution in the nation. INEEL scientists believe that the bioreactor can cost-efficiently compete with existing technologies, such as ion-exchange or reverse osmosis technology, in reducing selenium levels in contaminated waters in the Western United States to 5 ppb, which may soon be required by the U.S. Environmental Protection Agency.



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